

## **Acronyms and Abbreviations**

CHS Center for Homeland Security
D Division Decision Analysis Division
DIA Defense Intelligence Agency
DOE Department of Energy
DRC Division Review Committee
DTRA Defense Threat Reduction Agency

**EES Division** Earth and Environmental Sciences Division

**EES-2** Atmospheric, Climate, and Environmental Dynamics Group **EES-8** Atmospheric and Climate Sciences Group (merged with EES-2)

EES-9 Environmental Geology and Risk Analysis Group
EES-10 Environmental Dynamics and Spatial Analysis Group

(merged with EES-2)

**EM** Environmental Restoration and Waste Management (DOE)

**ESRI** Engineering Sciences and Applications Division **ESRI** Environmental Systems Research Institute

**GIS** Geographic Information System

**GISLab** Geographic Information System Laboratory

**HDBT** hard and deeply buried targets

**IGPP** Institute of Geophysics and Planetary Physics

NA Office of Nonproliferation Policy (DOE)

**NASA** National Aeronautic and Space Administration

NERI National Environmental Research Institute (Denmark)
NICHES National Institute for Computational Hydrology and

**Energy Sustainability** 

NIS Division Nonproliferation and International Security Division

NNSA National Nuclear Security Administration

**NWE** nuclear weapons effects

PIMS phosphate-induced metal stabilization
SELT Science and Engineering Leadership Team

**STRATCOM** United States Strategic Command

**T Division** Theoretical Division **X Division** Applied Physics Division

# Earth and Environmental Sciences Division— An Overview

Paul Weber, EES Division Leader pweber@lanl.gov

### **ORGANIZATION AND REORGANIZATION**

The Earth and Environmental Sciences (EES) Division was established in 1989. In late 2000, the division underwent a review by the Laboratory's associate director for Strategic and Supporting Research, which resulted in reorganization of the group structure and establishment of the Science and Engineering Leadership Team. The division leader left Los Alamos at that time, and nine months passed before a new division leader was appointed.

After a period of familiarization under the new leadership, we initiated a cultural change process that built on the structural changes. This process was driven by a representative team of division members who identified issues deemed worthy of the attention of the entire division. Through communications, division meetings, and a detailed questionnaire, we reached consensus on areas of potential improvement such as the need for defining a new vision and mission, a new analysis of our capabilities, a need to better engage in program development, and improvements in communications, including Web pages, publications, and seminars. These areas reflect actions and changes based on the strong consensus reached by the majority of division members who engaged in the cultural change process.

#### Vision

Our vision for the division is to provide outstanding scientific and engineering leadership, basic and applied research and development, and applications that benefit the environment, energy security, and national security.

#### Mission

Drawing upon capabilities in earth and environmental sciences and engineering, the EES Division provides solutions to complex problems of importance in the environment, energy, and national security.

# **Capabilities**

In developing our list of capabilities, we asked division members who engage in technical work to define the capabilities to which they contribute. In response, as an example, a mathematician engaged in hydrology identified a capabilities mix of 43 percent mathematics and 57 percent hydrology. Combining all of these allocations led to the following compilation of highest-ranked capabilities, listed alphabetically:

- Atmospheric and oceanic sciences
- Computational science and mathematics
- Ecology
- Geochemistry and geomaterials
- Geology
- Geophysics and seismology
- Hydrology
- National security science and technology
- Technical leadership and management.

## **Program Elements**

The main program elements and research highlights for the division are described in detail in the group summaries section of this report.

Our largest programs are Yucca
Mountain; the Waste Isolation Pilot
Plant, Carlsbad Operations; Tropical
Western Pacific sites of DOE'S
Atmospheric Radiation Measurements
Program; Ground-Based Nuclear
Explosion Detection for DOE/NA-22;
Nuclear Weapons Effects; Environmental Restoration for DOE/EM; and
portfolios of smaller projects for

DOE's offices of Fossil Energy and Science, Laboratory-Directed Research and Development, and others.

With the transition to program and line integration in the division, an explanation of which follows, Los Alamos will have many more opportunities to interface directly with sponsors, ensuring that they will continue to be pleased with our efforts and provide us with clearer insights into their current needs.

# Groups and Integrated Program Functions

As a part of the December 2000 reorganization, the division moved to a structure of six groups, with each group covering a particular set of capabilities. The Institute of Geophysics and Planetary Physics continued to report to the EES division leader. This structure worked well until October 1, 2002, when we merged EES-10, our smallest Los Alamos-based group, into two other groups, EES-8 and EES-9, for reasons of cost-efficiency.

At the time of the reorganization, it was clear that our reliance on program offices in other parts of the Laboratory to interface with our sponsors was a weakness within EES. The model in some other parts of the Laboratory was to align the program and line functions within the divisions, a practice that has worked very well in, for example, the Nonproliferation and International Security (NIS) Division since its for-

mation in 1993. We initiated discussions on this topic and, after lengthy deliberations, gained agreement on moving program functions into EES Division.

Specifically, the Yucca Mountain and Waste Isolation Pilot Plant Program offices were moved following the dissolution of the Environmental Sciences and Waste Division in April 2002. Effective October 1, 2002, we took over program management for most of the carbon sequestration and fossil energy portfolios.

evaluations by the division staff in concert with program managers and other leaders. We make investments of program development funds in these thrusts and develop the thrusts in collaboration with others. A brief description of each thrust follows.

## **Carbon Management**

The Carbon Management Thrust is broad in terms of both technical capabilities and sources of funding. Los Alamos performs research, development, science, and diagnostics in the Laboratory's breadth, depth, niche, and vision, and also on its balance of short-term and long-term carbon management approaches, to generate a strong, large, vibrant program. This effort is partially supported by institutional program development funds and is performed in strong collaboration with the Laboratory's new Office of Energy and Environment initiatives.

the Carbon Thrust is to capitalize on

**EES** has a great deal of expertise that can be put toward solving some of the nation's most pressing issues.

As program managers for the environmental elements of the DOE's Office of Science programs, we also have expanded the scope of our efforts to incorporate working directly on the new US Climate Change Initiative. With these changes, we now have direct program responsibility for over half of the division's work, and we believe that we are better positioned for growth.

Beyond maintaining and growing our existing programs, we see major opportunities in several areas. The choice of these areas is based on virtually all approaches to carbon management and sequestration strategies under investigation. These approaches include geological, clathrates, terrestrial, CO<sub>2</sub> mineralization, zero-emissions carbon, air extraction of CO<sub>2</sub>, seismic imaging, and ocean biogeochemistry. It is noteworthy that the Laboratory is making strong technical contributions in all key areas of carbon management and sequestration, and also that some long-term approaches and monitoring technologies were conceived in Los Alamos. The intent of

#### Water

The Water Thrust encompasses program development in the following areas: water for energy, DOE's Water Cycle Initiative, water security, NICHES. NASA interactions, and water technology. EES has been actively pursuing these initiatives for at least two years. Currently, EES principal investigators are involved in a Laboratory-Directed Research and Development project on the water cycle that highlights our capabilities in coupled modeling with highperformance computing. EES was also successful in obtaining DOE funding to support the Water Cycle Pilot Project. During the past year, workshops were held with stakeholders from industry and state government to identify critical issues in the allocation and use of water in energy production. Outcomes of these workshops were incorporated in a Senate bill that ultimately funded Sandia National Laboratories for desalination and arsenic removal, but did not

fund Los Alamos for predictive modeling. Nevertheless, EES has been encouraged to rewrite and resubmit a bill for consideration next year. This effort is partially supported by institutional funds and is performed in strong collaboration with the Office of Energy and Environment Initiatives.

## **Nuclear Weapon Effects**

The primary aspects of the Nuclear Weapon Effects (NWE) Thrust are

- Weapons functions
- Propagation path effects (earth and atmospheric)
- Sensors
- Target.

These primary capabilities have declined steadily at all of the weapons laboratories—Los Alamos. Lawrence Livermore, and Sandia since the end of the Cold War. The interest from the National Nuclear Security Administration (NNSA). Defense Threat Reduction Agency (DTRA), and management has recently increased. NNSA and DTRA are the primary customers. Other Los Alamos divisions involved in this thrust are Engineering Sciences and Applications (ESA). Decision Analysis (D). Nonproliferation and International Security (NIS), Theoretical (T), and Applied Theoretical and Computational Physics (X): other institutions involved are Sandia and Lawrence Livermore.

Applications that require NWE support include

- Survivability of US weapons in hostile environments
- Lethality of US weapons
- Detectability of foreign tests
- Containment
- Homeland vulnerability.

We held three workshops focusing on solid-earth effects, space and high-altitude effects, low-altitude effects, agent defeat, and weapons output, all of which are subareas of NWE. The workshops included individuals from each national laboratory. As a result of these efforts, the participating associate directors at Los Alamos, Lawrence Livermore, and Sandia endorsed a planning effort for consideration in budget planning for 2005–09, including a road map and total funds required.

## Hard and Deeply Buried Targets

The defeat of hard and deeply buried targets (HDBT) became a thrust within EES in 2001. Many targets worldwide require careful definition both in terms of the geology and the infrastructure that is hidden or protected by the geology. Geologic models definition and modeling weapons effects are the primary motivation behind EES involvement in this effort. Additional high-fidelity modeling of facilities is needed to assess target vulnerability. The geologic models

must include topography, lithology, target geometry, constitutive models for each rock type, and associated uncertainties for each of the model fields. Once geologic and infrastructure models are defined, hydrodynamic and seismic forward modeling of defeat weapons are applied to the model to determine the effects on the target.

To date, the HDBT Thrust at the Laboratory has defined a unique approach that involves members from DTRA and, at Los Alamos, D, EES, ESA, and X divisions. This approach includes a model definition that uses tools accessible to our primary customers (the United States Strategic Command and the Defense Intelligence Agency) and EES and D divisions' meshing and forward modeling of geologic structures and facilities. Thrust members have attended many technical meetings and produced publications.

# **Homeland Security**

The Center for Homeland Security (CHS) is being established at Los Alamos as the main interface to, and reflecting the structure of, the new federal Department of Homeland Security, which officially began operations in late February 2003. The situation is fluid, and, in preparation for moving quickly when opportunities arise, the Laboratory has designated each of the associate directors (Chemical and Biological, Nuclear and Radiological Security,

and Infrastructure) as points of contact within CHS.

## **Summary of Thrusts**

We will continue to review our thrusts to ensure that we are investing precious program development dollars wisely.

Science and Engineering **Leadership Team.** The Science and Engineering Leadership Team (SELT) was established during the 2000 EES reorganization. The vision for SELT is to help EES technical staff become more effective at obtaining research and development funds. SELT consists of from six to 10 members. including no more than one group leader or deputy group leader. In May of each year, the division leader, with input from SELT and the group leaders, appoints new members. They serve staggered two-year terms. Vacancies during the year may be filled at the discretion of the division leader. SELT performs the following activities:

- Gathers and shares information from program managers.
- Promotes collaborations.
- Improves skills in program development and leadership.
- Provides information to EES staff on avenues for building projects and programs and promoting new ideas.
- Aids EES staff in developing highquality proposals.

Assists in placing EES staff on Laboratory technical committees.

SELT meets weekly. Its meeting summaries are available online.

# Yucca Mountain Project Team Distinguished Performance

**Award.** Former Laboratory Director John Browne announced in October 2002 that the Yucca Mountain Project Team would receive the Large Team Distinguished Performance Award, a high honor. In part, the nomination memo reads as follows:

"The fact that the Secretary of Energy was able to recommend Yucca Mountain in the face of daunting political challenges is a testament to the outstanding science that the Yucca Mountain Program has been able to deliver. The Yucca Mountain Program staff has assisted in completing a major political and technological milestone by resolving a problem that has impact at the national level, bringing distinction to Los Alamos National Laboratory.

"The nominees of this award have truly excelled in their performance of the broad spectrum of scientific, engineering, technical, administrative, and management activities needed to provide the science, credibility, and defensible documentation that will allow DOE to move forward to the license application for our nation's first high-level nuclear waste repository, Yucca Mountain."

**Geographic Information** 

Systems Team Award. The Geographic Information System Laboratory (GISLab) was chosen from more than 100,000 user sites worldwide to receive the Special Achievement in GIS Award, which recognizes outstanding work in the GIS field. The presentation was made at ESRI's Twenty-Second Annual User Conference in recognition of the Laboratory's GIS efforts in support of the

and environmental monitoring under the Cerro Grande Rehabilitation Project. The award recognized the GISLab and the many EES employees at Los Alamos National Laboratory who contributed to GIS efforts.

## **Senior Staffing Changes**

On December 6, 2000, Associate Laboratory Director for Strategic and Supporting Research Thomas J. Meyer announced the completion of a



Fig. 1. The Yucca Mountain Project Team Distinguished Performance Award winners at Overlook Park, White Rock, NM.

Cerro Grande Rehabilitation Project. The Cerro Grande fire, which ravaged the town of Los Alamos as well as nearby mountain slopes in May 2000, burned more than 48,000 acres and caused evacuation of the Laboratory and town. GIS was integral to the response to the fire, and Los Alamos continues to use GIS for restoration

review and analysis of the EES Division. In addition, Division Leader Wes Myers announced that he was using that opportunity to step down from his post and accept a six-month assignment as acting deputy division leader of the Environmental Division, now dissolved.

At the completion of his short-term assignment, Myers relocated to Washington, DC, where he now provides technical and strategic advice and support for Office of Civilian Radioactive Waste Management activities with emphasis on international activities, science and technology, and Yucca Mountain repository development. Myers was the sole division leader of EES between the creation of the division in 1989 and its reorganization in 2001.

Kenneth Eggert, deputy division leader, served as acting division leader while a national search was conducted for a permanent leader.

### News Release, August 21,

**2001**—"Associate Laboratory Director for Strategic and Supporting Research Tom Meyer has announced the appointment of Paul G. Weber as leader of the Earth and Environmental Sciences Division, effective August 27th...

"Weber, whose primary technical experience is in plasma physics, space and atmospheric sciences, and remote sensing, said that he was excited by the appointment. 'I'm looking forward to getting started and working with the division's many talented employees. EES has a great deal of expertise that can be put toward solving some of the nation's most pressing issues. I am especially interested in enhancing links between EES and other organizations within the Lab and externally,' he said.

"Weber worked most recently on a special assignment to the Laboratory's Threat Reduction Directorate Office. Prior to that. Paul served in a number of leadership positions in the Nonproliferation and International Security Division. These included leading the Los Alamos work on the Multispectral Thermal Imager satellite and leading the Space and Remote Sensing Sciences Group. Weber also held research and management positions in the former Space Science and Technology Division and the Controlled Thermonuclear Research Division. Before joining the Laboratory, Weber worked as a research associate in the Applied Physics and Nuclear Engineering Department at Columbia University. Weber's bachelor and doctoral degrees in physics are from the Flinders University in South Australia."

#### News Release, May 2002—

"Gerald (Gary) Geernaert became the newest director of the Los Alamos branch of the Institute of Geophysics and Planetary Physics, a multicampus scientific research unit of the University of California. Geernaert comes to the Laboratory from the National Environmental Research Institute (NERI) in Denmark, where he was director of the Department of Atmospheric Environment. At NERI, Geernaert's department was responsible for coordinating and carrying out all research, monitoring, forecasting, and policy analysis associated with air

pollution in Denmark. Prior to joining NERI in 1994, Geernaert was a program manager for atmospheric systems and polar meteorology and a science officer for marine meteorology at the US Office of Naval Research in Arlington, VA...

"Geernaert received a bachelor's degree from the University of California at Davis in 1977 and a doctorate in atmospheric sciences from the University of Washington in 1983. He is the author of more than 80 scientific publications and four books.

His primary expertise is in meteorology, air pollution, air-sea interactions, remote sensing, and policy analysis. In addition, Geernaert holds adjunct faculty positions at the University of Copenhagen and the University of California at San Diego, and is currently chairman of the Danish Atmospheric Research Society."

#### **DIVISION REVIEW COMMITTEE**

The Earth and Environmental Sciences Division Review Committee (DRC) is appointed by the EES Division leader to review division activities and to advise division and Laboratory management regarding technical and operational activities. Members of the DRC, listed alphabetically, are:

#### Antonio Busalacci

Earth System Science Interdisciplinary Center

## Jeff Dozier

Donald Bren School of Environmental Science & Management

Institute of Geophysics and Planetary Physics, University of California at Santa Barbara

## J. Freeman Gilbert (Chairman)

Institute of Geophysics and Planetary Physics, University of California at San Diego

#### Rattan Lal

College of Food, Agricultural and Environmental Sciences, Ohio State University

## **Jean-Bernard Minster** (Alternate for Jeff Dozier)

Scripps Institution of Oceanography, Institute of Geophysics and Planetary Physics

## Alexandra Navrotsky

Department of Chemical Engineering and Material Science, University of California at Davis

#### Shlomo Neuman

Department of Hydrology and Water Resources, University of Arizona

#### Joanne Marie Nigg

Department of Sociology, University of Delaware

#### Veerabhadran Ramanathan

Center for Atmospheric Sciences

Scripps Institution of Oceanography, University of California at San Diego

#### **Leon Silver** (Member Emeritus)

Department of Geological Planetary Sciences, California Institute of Technology

#### Jefferson Tester

Laboratory for Energy and the Environment, Massachusetts Institute of Technology

#### M. Nafi Toksoz

Department of Earth, Atmospheric, and Planetary Sciences

Massachusetts Institute of Technology

#### Martinus Theodorus van Genuchten

US Salinity Laboratory, University of California at Riverside

#### Leland (Lee) Younker

Lawrence Livermore National Laboratory